

REMARKS

Applicant will address the three separate 35 U.S.C. 103 (a) obviousness rejections in the order they appear in the Office Action of 04/07/2006.

Streinz et al. ('686) in view Moeggenborg et al. ('762)

Claims 1, 3-9, and 11-18 stand rejected under 35 U.S.C. 103 (a) as obvious over Streinz et al. ('686) in view Moeggenborg et al. ('762). This rejection is moot with regard to Claims 1, 3-8, 17, and 18, that are now cancelled with the Present Amendment.

Applicants have amended Claim 9, so that it is clearly not obvious over these two references. Currently amended Claim 9 is directed to a low defectivity method for CMP of a substrate comprised of dielectric material.

Streinz et al. is focused on tungsten/titanium CMP with an oxidizing agent and a fluoride containing additive. The Streinz et al. composition may also contain a surfactant, which can be any type (cationic, anionic, nonionic, amphoteric). There is no disclosure in Streinz et al., nor even a hint thereof, of a method having the Present Application's inventive combination of an acetylenic alcohol with a fluoride salt to afford low defectivity CMP polishing of a substrate comprised of dielectric material.

Moeggenborg et al. discloses a CMP method for polishing a substrate containing a low-k dielectric layer with composition(s) that may contain an abrasive and an amphiphilic nonionic surfactant. As defined in Moeggenborg et al., an amphiphilic nonionic surfactant is a surfactant having a hydrophilic portion and a hydrophobic portion. Suitable hydrophobic

portions are disclosed in paragraph 14 of Moeggenborg et al.; suitable hydrophilic portions are disclosed in paragraph 15 of Moeggenborg et al.

All specific surfactants disclosed in Moeggenborg et al. have their hydrophilic and hydrophobic portions linked with a covalent bond (ester or ethereal linkages), such that there are no free hydroxyl groups present. These amphiphilic surfactants are essential in the compositions of Moeggenborg et al. in order for there to be a profound effect of removal rate of low-k dielectric material with surfactant concentration as shown in its examples (see especially Table 2, page 6 and paragraph 42).

The only disclosure in Moeggenborg et al. of an acetylenic alcohol surfactant having free hydroxyl groups is that of **Comparative** Example 4f, where 2,4,7,9-tetramethyl-5-decyne-4,7-diol (Surfynol 104PA) is the surfactant. As seen in Table 4 of page 7 of Moeggenborg et al., this surfactant **did not have a significant effect** upon the removal rate of low-K material in the compositions of Moeggenborg et al., and hence, was a comparative example.

There is absolutely no disclosure, nor even a hint thereto, in Moeggenborg et al. that relates to defectivity levels on polished substrates during CMP processing.

Hence, neither of these applied references, either alone or in combination, teach the Present Invention of a low defectivity CMP process, such as for oxide CMP, as exemplified in the examples.

Applicants have updated the Rule 132 Declaration by Dr. Junaid Siddiqui to reflect Dr. Siddiqui's review of the references and the rejections in the current office action. In this Declaration, Dr. Siddiqui reaffirms that the results of his earlier filed (02/21/2006) experimental work, as summarized in Table 2 (including footnotes #, ##, and !!), clearly indicate that use of compositions in oxide CMP containing hydroxy alkyne surfactant, plus ammonium fluoride affords **defectivity levels** on the polished wafers that are **at least 10-fold lower** than corresponding defectivity levels measured under comparable conditions for compositions in oxide CMP containing ethoxylated alkyne surfactant plus ammonium fluoride.

It has been and continues to be Dr. Siddiqui's opinion that these results show an **unexpected and significant result** of the Present Invention over the currently cited prior art, as well as the prior art cited in the earlier rejections.

The scope of the unexpected results of Dr. Siddiqui's Rule 132 Declaration is consistent with the scope of the claims that are now pending in the Present Application.

Ethoxylated alkyne surfactant is an example of amphiphilic nonionic surfactant of Moeggenborg et al. Ethoxylated alkyne surfactant is an **inventive surfactant in the Moeggenborg et al. patent application** but, in sharp contrast, is a **comparative one in the Present Application**.

Similarly, hydroxy alkyne surfactant is an **inventive one in the Present Application**, but, in equally sharp contrast, is **comparative one in Moeggenborg et al.** In this regard, Moeggenborg et al. **teaches away** from the Present Invention.

In summary, the Streinz et al. disclosure teaches use of any surfactant type (nonionic, cationic, anionic, amphoteric, etc.) in their compositions and methods using these compositions, and this teaching encompasses hundreds, if not thousands, of different possibilities. Moeggenborg et al. teaches amphiphilic nonionic surfactants (e.g. ethoxylated alkyne surfactant) for their inventive compositions, and there is one **comparative** example of an acetylenic alcohol surfactant.

With the combined teachings of these two references, one skilled in the art would be led to a choice of amphiphilic nonionic surfactants, which are outside the scope of the acetylenic alcohol surfactants of the Present Invention.

For the reasons presented above, Applicant asserts that the Present Invention, as reflected by the current amended claims, is patentable over Streinz et al. ('686) in view of Moeggenborg et al. ('762). Applicant respectfully requests reconsideration and removal of this rejection.

Misra et al. ('735) in view Moeggenborg et al. ('762)

Claims 1, 3-9, and 11-18 stand rejected under 35 U.S.C. 103 (a) as obvious over Misra et al. ('735) in view Moeggenborg et al. ('762). This rejection is moot with regard to Claims 1, 3-8, 17, and 18, that are now cancelled with the Present Amendment.

Applicants have amended Claim 9, such that it is clearly not obvious over the combination of these two references. Amended Claim 9 is directed to a low defectivity method for CMP of a substrate comprised of dielectric material.

Misra et al. teaches a CMP composition (and method for making the composition) containing an abrasive and an etching agent, which can be ammonium fluoride. The Misra et al. composition preferably includes a surfactant.

Misra et al. then teaches: "Suitable surfactants which can be used in the slurry compositions of the invention are known in the art and include, for example, Surfynol 440."

Thus, the only specific surfactant taught by Misra et al. is Surfynol 440, which is an ethoxylated surfactant and does not have any free hydroxyl groups. There is no disclosure in Misra et al., nor even a hint thereof, of the Present Application's inventive combination of an acetylenic alcohol with a fluoride salt to afford low defectivity CMP polishing of a substrate comprised of dielectric material.

Moeggenborg et al. discloses a CMP method for polishing a substrate containing a low-k dielectric layer with composition(s) that may contain an abrasive and an amphiphilic nonionic surfactant. As defined in Moeggenborg et al., an amphiphilic nonionic surfactant is a surfactant having a hydrophilic portion and a hydrophobic portion. Suitable hydrophobic portions are disclosed in paragraph 14 of Moeggenborg et al.; suitable hydrophilic portions are disclosed in paragraph 15 of Moeggenborg et al.

All specific surfactants disclosed in Moeggenborg et al. have their hydrophilic and hydrophobic portions linked with a covalent bond (ester or ethereal linkages), such that there are no free hydroxyl groups present. These amphiphilic surfactants are essential in the compositions of Moeggenborg et al. in order for there to be a profound effect of removal rate

of low-k dielectric material with surfactant concentration as shown in the examples (see especially Table 2, page 6 and paragraph 42).

The only disclosure in Moeggenborg et al. of an acetylenic alcohol surfactant having free hydroxyl groups is that of **Comparative** Example 4f, where 2,4,7,9-tetramethyl-5-decyne-4,7-diol (Surfynol 104PA) is the surfactant. As seen in Table 4 of page 7 of Moeggenborg et al., this surfactant did **not have a significant effect** upon the removal rate of low-K material in the compositions of Moeggenborg et al., and hence, was a **comparative** example. There is absolutely no disclosure, nor even a hint thereto, in Moeggenborg et al. that relates to defectivity levels on polished substrates during CMP processing.

Hence, neither of these applied references, either alone or in combination, teach the Present Invention's low defectivity CMP process, such as oxide CMP as exemplified in the Present Application's examples.

Applicant has updated the Rule 132 Declaration by Dr. Junaid Siddiqui to reflect his consideration of the references and rejections in the current office action. In this declaration, Dr Siddiqui reaffirms that the results of his previously filed (02/21/2006) experimental work, as summarized in Table 2 (including footnotes #, ##, and !!), clearly indicate that use of compositions in oxide CMP containing hydroxy alkyne surfactant plus ammonium fluoride afford **defectivity levels** on the polished wafers that are **at least 10-fold lower** than corresponding defectivity levels measured under comparable conditions for compositions in oxide CMP containing ethoxylated alkyne surfactant plus ammonium fluoride.

It has been and continues to be Dr Siddiqui's opinion that these results show an **unexpected and significant result** of the Present Invention over the prior art.

The scope of the unexpected results of Dr. Siddiqui's Rule 132 Declaration is consistent with the scope of the claims that are now pending in the Present Application.

Ethoxylated alkyne surfactant is an example of amphiphic nonionic surfactant of Moeggenborg et al. Ethoxylated alkyne surfactant is an **inventive surfactant in the Moeggenborg et al.** patent application but, in sharp contrast, is a **comparative one in the Present Application.**

Similarly, hydroxy alkyne surfactant is an **inventive one in the Present Application,** but, again in sharp contrast, is **comparative one in Moeggenborg et al.** In this regard, Moeggenborg et al. **teaches away** from the Present Invention.

In summary, the Misra et al. disclosure teaches, for CMP processing, use of surfactants known in the art and only discloses one specific surfactant, which is Surfynol 440, an ethoxylated surfactant not having any free hydroxyl groups and which is an amphiphilic nonionic surfactant, as disclosed in Moeggenborg et al. This broad teaching of surfactants known in the art encompasses hundreds, if not thousands, of different possibilities. Moeggenborg et al. teaches a choice of amphiphilic nonionic surfactants (e.g. ethoxylated alkyne surfactant) for their inventive compositions, and there is one **comparative** example of an acetylenic alcohol surfactant.

With the combination of these two references, one skilled in the art would be led to a choice of amphiphilic nonionic surfactants, which are outside the scope of the acetylenic alcohol surfactants of the Present Invention.

For the reasons presented above, Applicant asserts that the Present Invention, as reflected by the current amended claims, is patentable over Misra et al. ('686) in view of Moeggenborg et al. ('762). Applicant respectfully requests reconsideration and removal of this rejection.

Pasqualoni et al. ('913) in view Moeggenborg et al. ('762)

Claims 1, 3-9, and 11-18 stand rejected under 35 U.S.C. 103 (a) as obvious over Pasqualoni et al. ('913) in view Moeggenborg et al. ('762). This rejection is moot with regard to Claims 1, 3-8, 17, and 18, that are now cancelled with the Present Amendment.

Applicant has amended Claim 9, such that it is clearly not obvious over the combination of these two references. Amended Claim 9 is directed to a low defectivity method for CMP of a substrate comprised of dielectric material.

Pasqualoni et al. teaches a CMP composition, which can contain an abrasive (colloidal silica), a fluoride salt (ammonium fluoride) and a surfactant. Suitable surfactant compounds of the Pasqualoni et al. compositions, include; "for example, any of the numerous nonionic, anionic, cationic or amphoteric surfactants known to those skilled in the art." In other words, the Pasqualoni et al. compositions may contain any known surfactant (and there are hundreds, or perhaps thousands, of known surfactants) without any guidance or preference for choice of surfactant being taught by this reference.

There is no disclosure in Pasqualoni et al., nor even a hint thereof, of the Present Invention's inventive combination of an acetylenic alcohol with a fluoride salt to afford low defectivity CMP polishing of a substrate comprised of dielectric material.

Moeggenborg et al. discloses a CMP method for polishing a substrate containing a low-k dielectric layer with composition(s) that may contain an abrasive and an amphiphilic nonionic surfactant. As defined in Moeggenborg et al., an amphiphilic nonionic surfactant is a surfactant having a hydrophilic portion and a hydrophobic portion. Suitable hydrophobic portions are disclosed in paragraph 14 of Moeggenborg et al.; suitable hydrophilic portions are disclosed in paragraph 15 of this reference.

All specific inventive surfactants disclosed in Moeggenborg et al. have their hydrophilic and hydrophobic portions linked with a covalent bond (ester or ethereal linkages) such that there are no free hydroxyl groups present. These amphiphilic surfactants are essential in the compositions of Moeggenborg et al. in order for there to be a profound effect of removal rate of low-k dielectric material with surfactant concentration as shown in the examples (see especially Table 2, page 6 and paragraph 42).

The only disclosure in Moeggenborg et al. of an acetylenic alcohol surfactant having free hydroxyl groups is that of **Comparative** Example 4f, where 2,4,7,9-tetramethyl-5-decyne-4,7-diol (Surfynol 104PA) is the surfactant. As seen in Table 4 of page 7 of Moeggenborg et al., this surfactant **did not have a significant effect** upon the removal rate of low-K material in the compositions of Moeggenborg et al., and hence, was a comparative

example. There is absolutely no disclosure, nor even a hint thereto, in Moeggenborg et al. that relates to defectivity levels on polished substrates during CMP processing.

Hence, neither of these applied references, either alone or in combination, teach the Present Invention of a low defectivity CMP process, such as oxide CMP as exemplified in the Present Application's examples.

Applicants have updated the Rule 132 Declaration by Dr. Junaid Siddiqui to reflect his consideration of the references and rejections in the current office action. In this declaration, Dr Siddiqui reaffirms that the results of of his previously filed (02/21/2006) experimental work, as summarized in Table 2 (including footnotes #, ##, and !!), clearly indicate that use of compositions in oxide CMP containing hydroxy alkyne surfactant plus ammonium fluoride affords **defectivity levels** on the polished wafers that are **at least 10-fold lower** than corresponding defectivity levels measured under comparable conditions for compositions in oxide CMP containing ethoxylated alkyne surfactant plus ammonium fluoride.

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Moeggenborg et al. patent application, but, in sharp contrast, is a **comparative one in the Present Application**.

Similarly, hydroxy alkyne surfactant is an **inventive one in the Present Application**, but is **comparative one in Moeggenborg et al.** In this regard, Moeggenborg et al. **teaches away** from the Present Invention.

In summary, the Pasqualoni et al. disclosure teaches use of any surfactant type (nonionic, cationic, anionic, amphoteric, etc.) in their compositions, and this teaching encompasses hundreds, if not thousands, of different possibilities. Moeggenborg et al. teaches choice of amphiphilic nonionic surfactants (e.g. ethoxylated alkyne surfactant) for their inventive compositions, and there is one **comparative** example of an acetylenic alcohol surfactant.

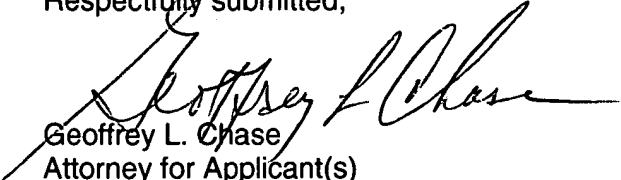
With the combination of these two references, one skilled in the art would be led to a choice of amphiphilic nonionic surfactants, which are outside the scope of the acetylenic alcohol surfactants of the Present Invention.

For the reasons presented above, Applicant asserts that the Present Invention, as reflected by the current amended claims, is patentable over Pasqualoni et al. ('913) in view of Moeggenborg et al. ('762). They respectfully request removal of this rejection.

Conclusion

Applicant believes that with the amended claims, the unexpected results of Dr. Siddiqui's re-submitted Rule 132 Declaration and arguments presented in this Amendment, that all outstanding rejections have been addressed and respectfully request reconsideration based upon the amendments, the declaration and remarks and the early issuance of a Notice of Allowance.

Respectfully submitted,



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Attachment: Re-submitted Rule 132 Declaration of Dr. Siddiqui